Generation IV Overview

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28 August 2003

GENERATION IV
nuclear energy systems

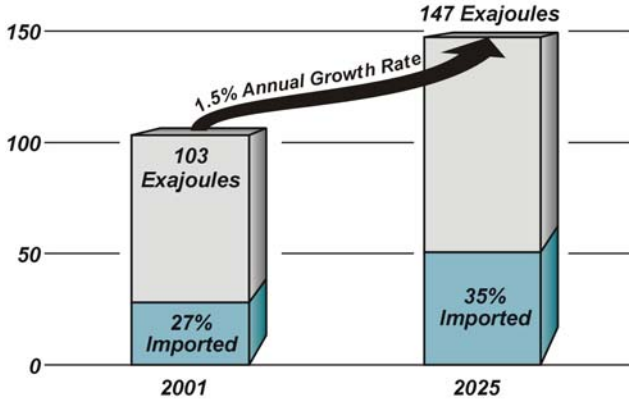
Outline

- *U.S. Generation IV Implementation*
- *Current Activities and Plans for each System*
- *Crosscutting Activities*
- *Generation IV International Forum (GIF) Progress*

U.S. Gen IV Implementation Plan

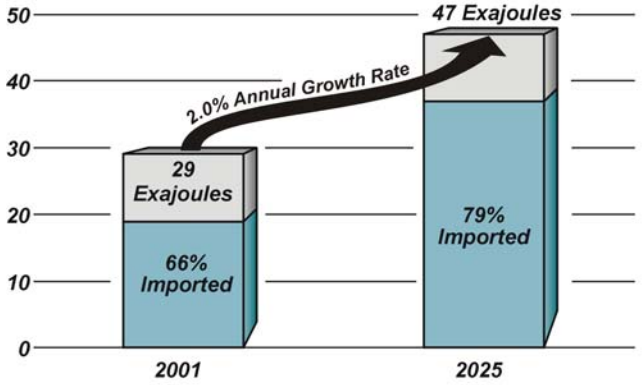
- ***Requested for 31 Mar 2003***
- ***Currently in Review, Expected to Issue Soon***
- ***Highest priority proposed on meeting expanding electricity and potential hydrogen supply needs***

Growing U.S. Energy Demand and Imports
U. S. Total Energy Consumption (Exajoules)



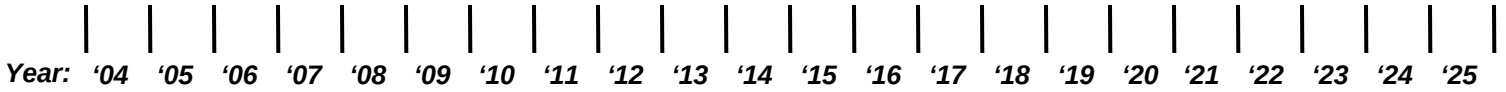
Source: 2003 Annual Energy Outlook
03-GA50119-02a

Growing U.S. Transportation Sector Energy Demand and Imports
U. S. Transportation Sector Energy Consumption (Exajoules)

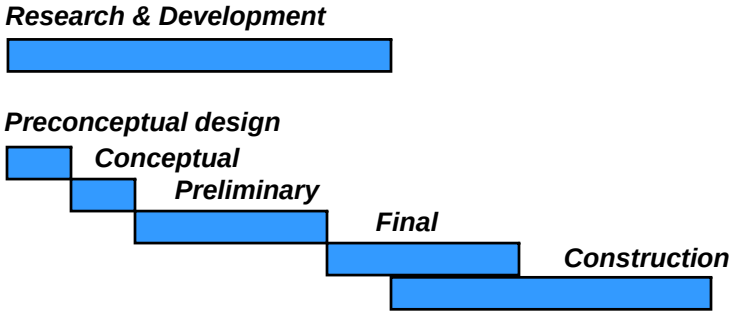


Source: 2003 Annual Energy Outlook
03-GA50119-02b

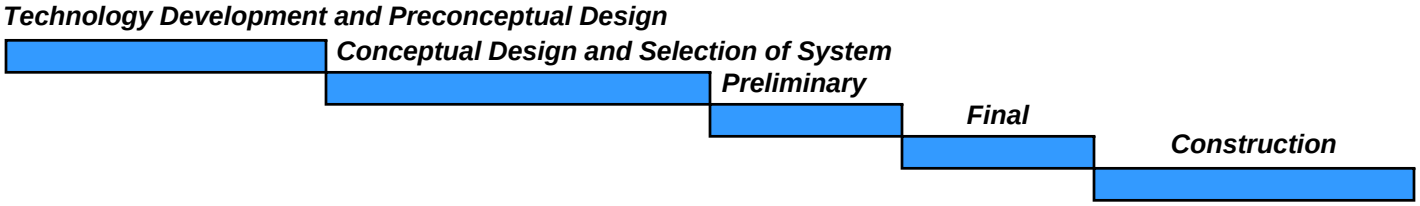
Proposed Timelines



Priority 1: Nuclear-Assisted Hydrogen Production System



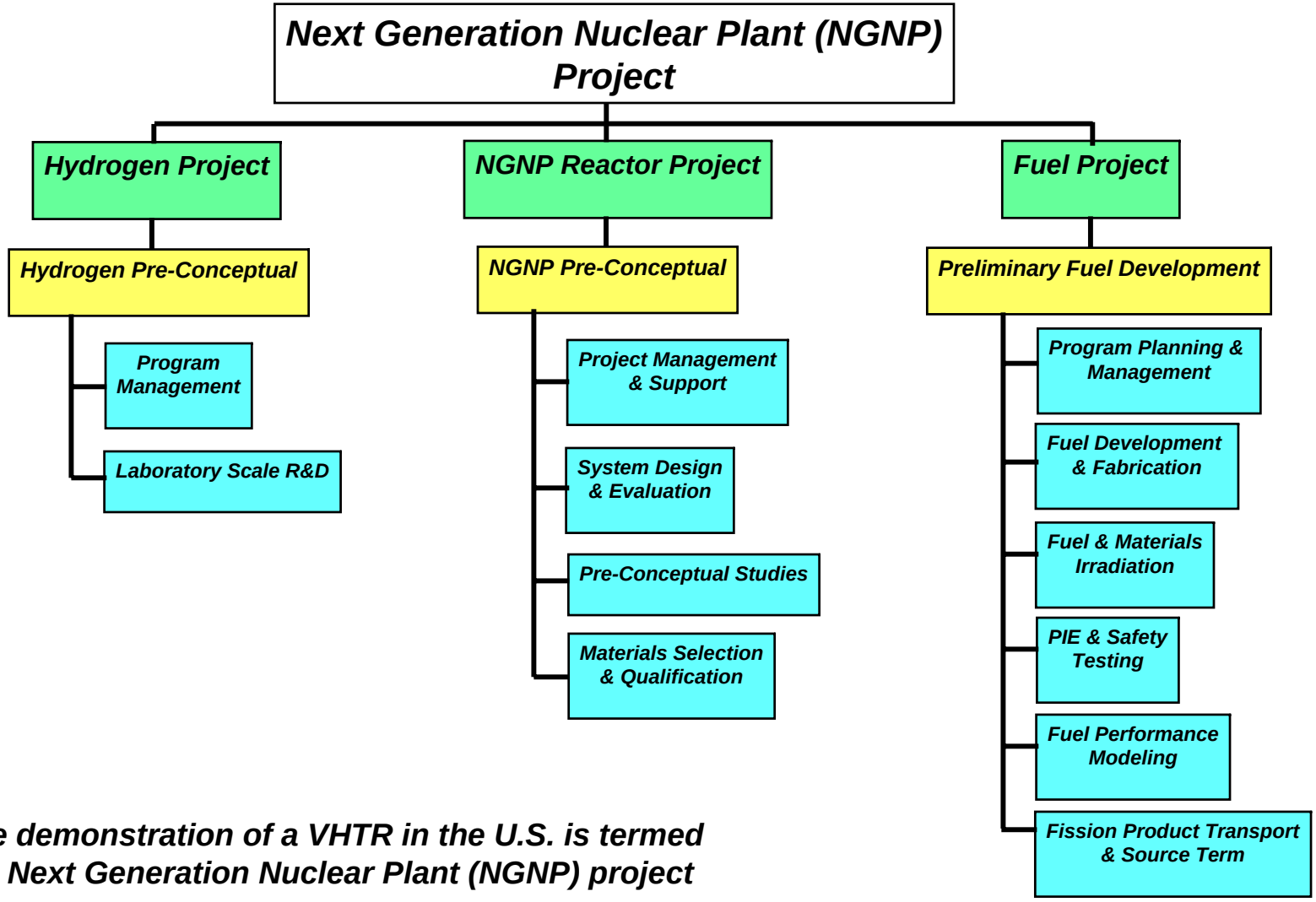
Priority 2: Sustainable Nuclear Energy System



Generation IV Activities

	Target	Required
NGNP	4,920	20,000
GFR	820	1850
LFR	820	1850
SCWR	820	1850
SFR	40	40
MSR	40	40
SD&E	800	1190
Materials	800	1480
E Conv	200	585

NGNP* Activities



* *The demonstration of a VHTR in the U.S. is termed the Next Generation Nuclear Plant (NGNP) project*

GFR Activities

- *System Design and Evaluation*
  - *Down-select passive or active systems for reference and optional designs*
- *Fuel and Fuel Cycle*
  - *Begin fabrication and out-of-pile testing of fuel/fuel matrix specimens*
- *Materials*
  - *Begin initial material corrosion tests for supercritical CO_2 service, and perform joining tests for ODS specimens*
- *Energy Conversion*
  - *Develop turbomachinery and power cycle design for supercritical CO_2 cycle**

This work is being performed under Energy Conversion

LFR Activities

- *Materials*
  - *Screen/assess Pb/Pb-Bi compatibility of materials with known or anticipated acceptable irradiation performance*
- *Pb/Pb-Bi Coolant Technology*
  - *Coolant chemistry*
  - *Flow measurement & modeling*
  - *Thermal hydraulic characteristics in representative geometries*
- *System Design & Evaluation*
  - *Long-life core design*
  - *Thermal hydraulic design for passive safety, natural circulation, and autonomous load following*
- *Institutional and Deployment Issues*
  - *Deployment and economic analysis*
  - *Non-proliferation requirements & assessment*

SCWR Activities

- *System Design and Evaluation*
  - *Core flow stability analysis*
  - *Safety systems and reactor protection logic*
- *Materials*
  - *Survey of available materials (from SC fossil systems) for application in the SCWR radiation environment*
  - *Corrosion testing of candidate materials*
- *Energy Conversion*
  - *Balance of plant design, control and startup*

SFR Activities

- ***Exploratory Activities***
  - ***GIF Steering Committee participation***

MSR Activities

- *Exploratory Activities*
  - *Limited concept development*
    - *Brayton cycle*
    - *Compact heat exchangers*
  - *Identify major technical challenges*
    - *Tritium control*
    - *Salt freeze-out*
    - *Chemistry control*
  - *Identify potential international collaborators*

SD&E Crosscut

- *Design Analysis Capabilities*
  - *Key phenomena and figures of merit*
  - *Priority modeling and data needs*
  - *Benchmark test survey*
- *Evaluation Methodology Working Group*
  - *Fuel cycle cost model*
  - *Integrated economic model specifications*
  - *Non-electrical product cost model*
  - *Begin software implementation*
- *Proliferation Resistance & Physical Protection Working Group*
  - *Develop methods for evaluating PR&PP metrics*
  - *Explore approaches for characterizing uncertainty*
  - *Application tests*

Materials Crosscut

- *Materials for Radiation Service*
- *Materials for High-Temperature Service*
- *Microstructural Modeling*
- *High-Temperature Design Methodology*
- *Reactor-Specific Materials*
  - *Graphite*
  - *Materials Compatibility*
  - *Structural Composites*
- *Materials for Energy Conversion*

- *Coordination of NGNP-Specific Materials Tasks*
- *Coordination of other Specific Materials Tasks*

Energy Conversion Crosscut

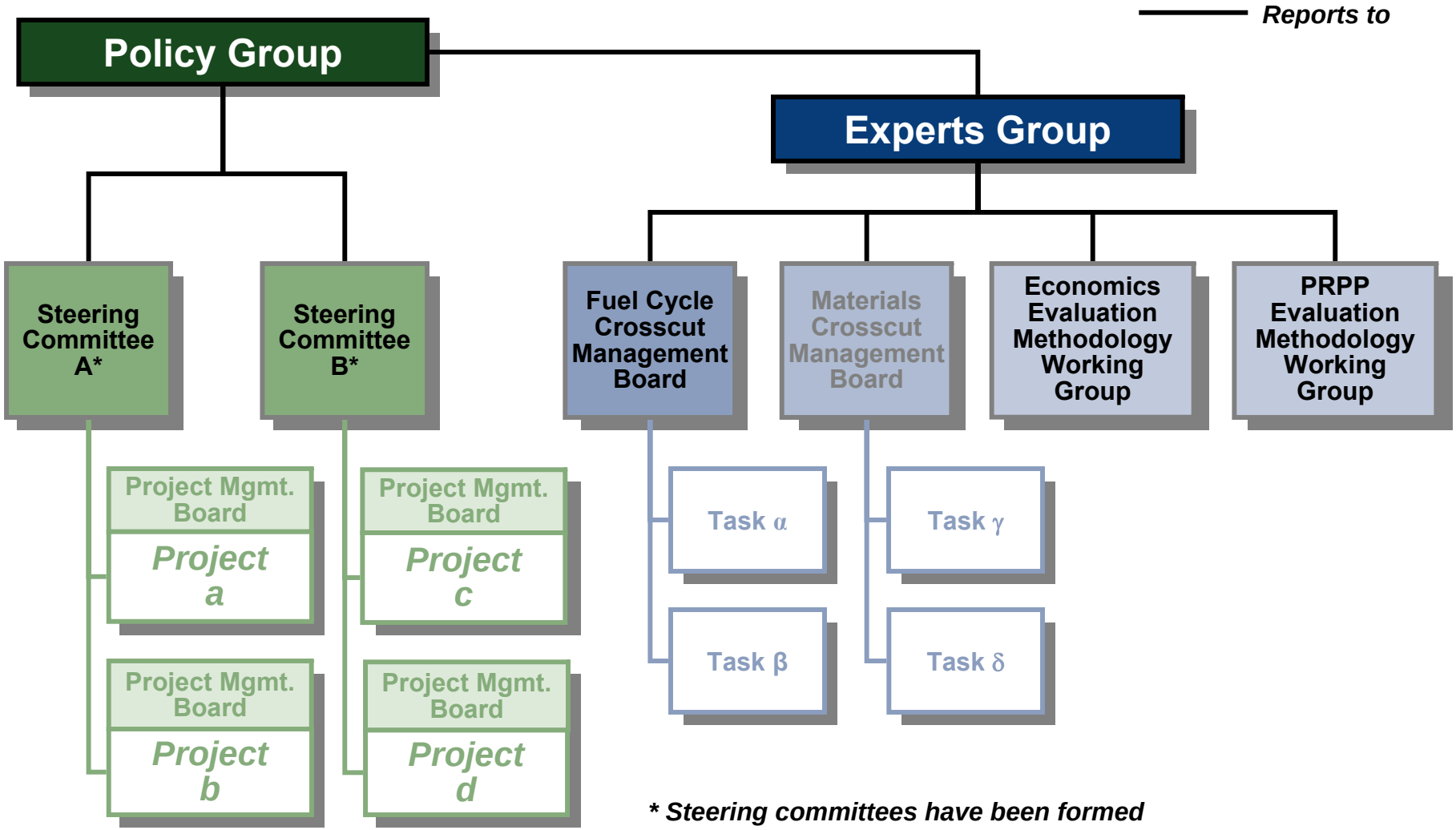
- *Thermochemical Cycles*
  - *Sulfur based reaction demonstration*
  - *Alternate cycles (Ca-Br, others)*
  - *Membrane technology*
- *High Temperature Electrolysis*
  - *HTE conceptual designs*
  - *Scaling experiments*
  - *Pilot plant interface*
- *Hydrogen Systems and Balance of Plant*
  - *Hydrogen systems analysis and interface*
  - *Heat exchanger development*
  - *Pilot plant interface*
- *Advanced Electrical Conversion Cycle Studies*
  - *Advanced electrical cycle analysis*
  - *Supercritical CO2*
  - *Advanced Brayton cycle design studies*
- *Hydrogen Program Interface*

GIF Activities in 2003

- *Policy Group met 18–19 Mar 2003 in Cape Town*
- *PG Created four 'Provisional' Steering Committees, reporting to the Policy Group*
  - *GFR, SCWR, SFR and VHTR*
- *'Provisional' Steering Committees will plan the R&D, and begin limited collaborations*
- *PG Created one crosscutting Management Board, with an emphasis on fuel cycle R&D, reporting to the Experts Group*
- *PG Asked that the Experts Group prepare recommendations on the Organization and Conduct of Crosscutting R&D*

- *Experts Group met 23–24 Jul 2003 in San Francisco*
- *Policy Group will meet 24–26 Sep 2003 in Toronto*
- *Euratom approved for GIF membership*

Proposed GIF R&D Organization



** Steering committees have been formed for the GFR, SCWR, SFR and VHTR*

30 July 2003

Summary

- *U.S. priorities are focused on NGNP, LFR, SCWR and GFR; NGNP may elevate to a demonstration project*
- *System-specific R&D is focused on key viability issues; Systems are being asked to 'baseline' their best option in FY 03 for incorporation into AFCI systems analysis*
- *GIF is preparing R&D plans through its system steering committees; Agreements may be in place within a year*
- *Economics and proliferation resistance & physical protection working groups are advancing the evaluation methodologies*
- *Transmutation requirements will be fed back into the relevant fast-spectrum systems*
- *Opportunities for common tasks between AFCI and Generation IV are being exploited*